Haggerty, M. E. Imitation in monkeys. (1909)

wondering why he was so bent upon clearing the matter up. At most it could only put him where he was before the day of the accident. It could not make that drive home real or change in her utterances what she had said that afternoon. She would acquit him of prying into her affairs, but beyond that there was nothing to hope. Everything that he had recently learned strengthened his conviction that she was going to marry Wynford. It was a certainty. Nevertheless, from Crumpelow Hill he rode toward the Abbey.

It was nearly four o'clock when Miss Rivers came in. He rose and bowed with a playful, exaggerated ceremony. "I have come," he began, in a studiedly light key, "because I have solved the mystery."

"I am glad you have come," she said.

"It is simple," he went on. "Another man picked you up, and put you where I found you. Your breathing must have been bad, and he loosened your clothes. Probably the locket had flown open and he shut it. Then he went after a trap. Why he did not come back, I don't know."

"But I do," said Miss Rivers.

He looked at her warily, suspecting a trap for the man's name. He preferred not to mention that.

"I know," she went on, "because he has told me. He did come back part way—till he saw that you were with me."

Mr. Carteret looked at her in surprise.

"More than that," she went on, "he did close the locket, and, after thinking about it, he decided that it was best to tell me. If he had only done so before!"

"I see," said Mr. Carteret. He did not see at all, but it was a matter about which he felt that he could not ask questions.

"You know," she said, after a pause, "that the man was Captain Wynford."

"Yes," he answered shortly. His tone changed. "Wynford is a good man—a good man," he said again. "I can congratulate you both honestly." He paused. "Well, I must go," he went on. "I 'm glad things are right again all round. Good-by." He crossed to the door, and she stood watching him. She had grown very pale.

"Carty," she said suddenly, in a dry voice, "I 'm not acting well."

He looked back perplexed, but in a moment he understood. She evidently felt that she ought to tell him outright that she was going to marry Wynford.

"In treating you as I did," she finished, "in judging you—"

"You were hasty," he said, "but I can understand."

She shook her head. "You can't understand if you think that there was only a flower in the locket."

"Perhaps I have guessed already that there was a picture," he said—"a picture that was not for my eyes."

She looked at him gravely. "No," she said, "you have n't guessed. I don't think you 've guessed; and when I think how I misjudged you, how harsh I was, I want you to see it. It is almost your right to see it." Her hand went to her throat, but he shook his head.

"It pleases me," he said, "to be made a confidant, but I take the will for the deed. If there is anything more you might wish that I would say, imagine that I have said it—congratulations, good wishes, and that sort of thing; you understand." His hand was on the door, but again she called him back. She paused, with her hand on the piano, and struggled for her words. "Carty," she said, "once I told you that it was all off, that I never could marry you—that I should never marry any one. You 're glad now, are n't you? You see it is best?"

"Would it make you happier if I said so?" he replied.

"I want to know the truth," she said.

"I am afraid the truth would only hurt you," he answered.

"I want the truth," she said again.

"It is soon told," he said; "there is nothing new to tell."

"What do you mean?" she whispered.

"Is n't it clear?" he answered. "Do you want to bring up the past?"

"You love me?" she asked. He could hardly hear, her voice trembled so.

He made no answer, but bowed his head.

When she saw, she turned, and, throwing her arms along the piano, hid her face, and in a moment he heard her crying softly.

He paused uncertainly, then he went to her. "Sally," he said.

She lifted her head. She was crying

still, but with a great light of happiness in her face. "There is no Captain Wynford," she sobbed. "If you had looked in the locket—" A laugh flashed in her eyes.

And then he understood.

THEY were standing close together in the mullioned window where three hundred years before a man standing on the lawn outside had scrawled with a diamond on one of the little panes:

If woman seen thro' crystal did appere
One half so loving as her face is fair

And a woman standing inside had written the answering lines:

Were woman seen thro', as the crystal pane,
Then some might ask, nor long time ask in ——

The rhyme word was indicated by a dash, but neither the tracings of those dead hands, nor the ancient lawns, nor the oaks that had been witness, did these two see. When many things had been said, she opened the locket.

"You must look now."

"I will," he said. As he looked, his eyes grew misty. "Both of us?" he whispered.

"Both of you!" she answered. And it was so, for in the corner of the picture was Penwiper.

IMITATION IN MONKEYS

BY MELVIN E. HAGGERTY

WITH PICTURES OF MONKEYS FROM PHOTOGRAPHS MADE BY MR. E. R. SANBORN, STAFF PHOTOGRAPHER OF THE NEW YORK ZOÖLOGICAL PARK

POPULAR literature abounds in stories of the imitative tendency of monkeys. Doubt as to the scientific truthfulness of such anecdotes was raised by Professor Thorndike's experiments, which failed to reveal any imitative ability on the part of the three monkeys which he studied. His work, and that of succeeding investigators, has been set forth in a recent article[1] by Professor Robert M. Yerkes, and need not be repeated here. It is sufficient to note that experimental evidence, as produced by Thorndike, Kinnaman, Hobhouse, and Watson, has been of a conflicting nature. It leaves the question still unsettled, and strongly suggests the need for further investigation. Within the past year the writer has conducted a series of experiments the aim of which was to further the solution of the imitation question. Specifically, the aim has been to discover if monkeys learn to do things by seeing other monkeys do them.

My work began in the psychological laboratory of Harvard University in 1908. Jack and Jill arrived in Cambridge one November day, and took up their abode in the animal room of the laboratory. They had been purchased in New York, and all concerned were delighted to find them fine specimens of Cebus monkeys, apparently about three years old. This is the genus with which we are all familiar as consorts of organ-grinders.

Jill was happy from the start, and on the third day would sit on my knee and eat her banana out of my hand. Within a short time she would ride on my shoulder as I walked about the laboratory, thus being sure to keep near whatever food I might have in my hand. Jack, however, was more cautious, never coming near unless Jill was preceding him, and retreating whenever he got his food. His favorite position was sitting on the floor of the cage, with Jill sitting in front, and his arms clasped tightly about Jill's body. When Jill moved, Jack would start nervously and try to keep close to her, never once taking his sparkling brown eyes off

[1] See "Imitation among Animals," by Professor Yerkes in the July CENTURY.

the persons in the room. Gradually, however, his fears wore off, and with Jill he went curiously about the cage, biting at every piece of wood, and poking his fingers into every crack and cranny. A small tree was placed in the cage, and the animals could then stretch their tails by wrapping the tip-end around a branch and suspending their whole weight from the limbs, a performance apparently as enjoyable to the monkeys as swimming is to the average boy.

The animals did not like to be separated. Jack was especially concerned when Jill came out to get food and he was left alone. Often when alone he would utter a shrill, piercing sound, a veritable bark. This was much unlike their usual noises of whistling and crying, and I took it to be a danger-signal, for Jill never failed to climb the cage, window, or anything else near her, when the cry was given. Even when, after a day's fast, she was greedily eating her banana, it would be left with startling suddenness, and she would make no delay until she was at the highest point in the room. She never looked about to discover the danger for herself and never ran on the floor. Her action was always an impetuous scramble to get *up*. She never remained up long, and often came down immediately. I never heard her utter the cry. Jack sometimes gave it when she was out of sight, but again when she was in plain view and when there was no disturbance in the room. In the wild state, such a cry is probably the signal that some enemy is near, and when given, all that hear it scud to the tree-tops as the place of greatest safety.

After a few weeks in the laboratory, Jill acquired a pugnacious attitude toward certain persons, usually strangers. I first noticed it one day when the expressman called to leave a package. He entered without noticing her, and when he turned to leave, she was on a cage which he must pass in going to the door. Her mouth was open, her teeth showing, and her body was drawn into a crouching attitude, as if about to spring. I intervened, for fear she might bite or scratch him; she was of course incapable of doing serious harm. A day or two later she behaved in the same way toward the laboratory mechanic who came in to do some work. As he went toward the door, her fury increased like that of a dog after a retreating enemy. I began to suspect there was more of bluff than fight in her behavior, and my doubts as to her courage were fully justified a few days later. Experiments were over for the day, and Jill was having her freedom about the room, to the delight of the several persons present. A stranger entered the room. She was at the opposite end, and on top of a six-foot cage, when he entered. She immediately prepared for war, and her scolding and threatening began. She advanced toward him with short leaps, which grew shorter as she neared him. Her scolding increased; her hair became erect; her lips drew back; her keen teeth were ready to bite, and although her jumps shortened, her anger increased. Suddenly she leaped from the cage toward him (most men would have dodged or struck, but this man did neither) and landed plump upon his chest. Instantly her harsh cries became more like the purr of a cat, and her hand found its way to his jeweled tie-pin and on up to his mustache. They were to be friends!

One of the happiest days in Jill's laboratory experience was the day I hung a rope in the experiment cage. It was an inch rope suspended from the top. Jill leaped to it from the wire side of the cage, and grasped it with hands, feet, and tail. As she swung, pendulum-like, back and forth, her eyes were bright and the corners of her wide-open mouth were drawn back as if she were trying to laugh. It was evidently the expression of delight, and although she uttered no sound, it came nearer to a laugh than I have seen on any other animal except the apes. Ever after, the swing was a favorite bit of sport for her.

Jack never assumed the bluffing attitude toward persons, and he never learned to climb the rope during his life in Cambridge. The animals always seemed hungry, though they were fed each day with a good supply of raw peanuts, sunflower seed, apples, and bananas. Cornmeal mush, meat scraps, milk, and hard-boiled eggs were given occasionally. Meal worms were a delicacy offered for good work.

As soon as the monkeys were accustomed to their new home, I began some preliminary experiments. The desire to get food was used as a motive to induce them to work, about as constant a motive

with a Cebus monkey as one can well imagine.

A somewhat detailed account of the first regular experiment will set in relief the method which I used. The first experiment cage was approximately three by four by six feet. The back and one end were of boards, while the front and the other end

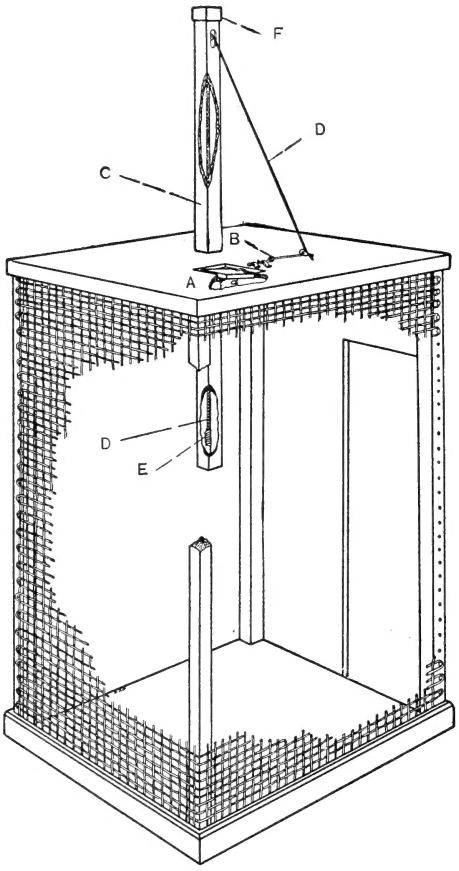


DIAGRAM OF THE FIRST EXPERIMENT CAGE

A, trap-door; B, device to hold door closed; C, chute; D, string, the pulling of which opened the trap-door; E, piece of iron fastened to the end of the string; F, cap covering top of chute.

were of mesh wire. In the top of the cage, near the wire front and the wire end, was a door four inches square which opened inward, and was held shut by a device on top of the cage. At a point in the top, nearer the board end and the back, a hollow chute two and a half inches square projected perpendicularly into the cage about two feet. From the device which held the door shut, a string passed to the chute, and hung down on the inside to within four inches of the bottom. The top of the chute was covered so that no light could come through. In order to secure food, the monkey must leap from the wire part of the cage to the chute, and, while holding to it, must thrust a hand up inside and pull the string, thereby releasing the small door in the top of the cage and allowing the food which had been placed on it to fall to the floor. He must then descend to the floor to get the food.

To give the monkeys a fair chance to learn the act, each was tried alone for thirty minutes a day for several days. Jack was first put into the cage on January 4. Within a few minutes he had jumped to the chute, but he took no notice of the end of it. On the second trial, his random leaps so jarred the cage that the food-door in the top of the cage dropped open and the peanuts fell to the floor. He ate the nuts and then climbed the wire. Holding with his feet, he reached the swinging door with his hands, and thrust his head up through the opening. He had made one necessary association on the road to solving the problem: he knew where the food came from. On January 8 he made more progress. He was active about the cage, and on his seventh leap to the chute he threw his head and shoulders downward while hanging by his tail and feet. He looked up the chute; then up went a hand, and a moment later there came a vigorous pull which opened the trap, and the peanuts rolled on the floor of the cage. Down he went for the food, and I thought Jack had learned. However, I was too generous in my interpretation, for during the remaining twenty minutes he played about the cage, jumping to the chute twenty times, but never once displaying the slightest indication that he knew of an opening in the end of it. It required three more days for him to learn to satisfy his hunger by pulling the string. On January 20 he operated the mechanism ten times in twenty-seven minutes. I then counted him to have learned the trick.

Jill was not so fortunate. She had her first experience in the experiment cage on January 7, and being hungry, she scolded and chattered most of her thirty minutes. Despite her impatience, she searched the floor for food and climbed the wire, but I could not tell that she even looked at the

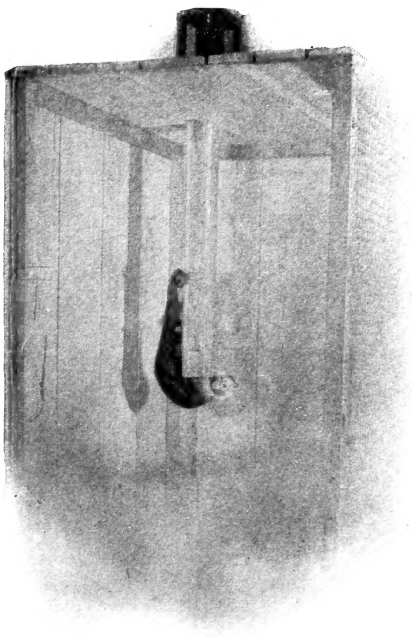
JACK. *CEBUS LUNATUS*, THREE YEARS OLD
He solved three of the problems alone; the other four he learned by imitation.

chute. For eleven days she repeated this behavior, during the later days scolding much less and examining the cage more. Every corner and crack on the floor, sides, or top of the cage that could be reached was explored by Jill's curious nose and fingers. Yet in all the fifteen half-hours, on as many different days, Jill paid no attention to the chute. So impossible did it seem that in her vigorous activity she should leap all about the cage, almost directly past the chute at times, and never once jump to it, that on January 23 and January 24 I called in other observers to verify my reports. On these days her behavior was the same, and we were all agreed that it was not probable that Jill would learn of her own accord. We were also agreed that the conditions were excellent to test whether Jill could learn from Jack.

Accordingly, on January 25, I placed the two animals in the cage together. Jack was quick at his work, and with great dexterity he set the copy for Jill seven times within a few minutes. Jill saw the entire performance twice and in part at least four other times. Jack was then removed from the cage, and Jill was left alone for thirty minutes. I quote here from the notes for the day: "After a few minutes of climbing about, Jill looked up at the chute from the floor; she stood on her feet, lifted her body and face upward, climbed the side of the cage as if she were making straight for the side of the chute, but she did not jump across. During the remainder of the interval there was no evidence that Jill was influenced by what she had seen."

Jack was again placed in the cage and allowed to operate the mechanism. Each time Jill got food, and at times took all of it. Twice again she saw the entire performance and four times saw it in part. Jack was then removed. During the thirty minutes that followed there was not the slightest thing to indicate that the performance of Jack had influenced Jill.

These imitation tests were repeated on sixteen different days. Jack operated the device a total of two hundred and fifty-three times, two hundred and four of which Jill saw entire. On no day did she see the entire performance fewer than three times nor oftener than twenty times, and after each day's observation she was given thirty minutes. The nearest approach to imitation was on February 6. After Jack was taken out, she climbed the cage near the chute. Holding with feet, tail, and one hand, she threw her head and body out from the cage, extending the free hand as if reaching for the chute. She did not jump. Poor stupid Jill would apparently have starved to death with a load of bananas on top of the trap-door, and



JACK GETTING FOOD IN THE CHUTE EXPERIMENT

NO. 4. *CEBUS FATUELLUS;* FEMALE, EIGHT YEARS OLD

The "boss" of a large cage full of monkeys and very strong. This animal was so quick in movement that it was impossible to get a clear picture of her.

only a leap to make and a string to pull to drop them into the cage.

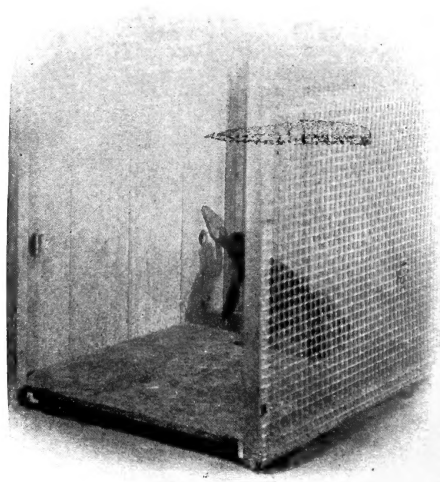
If one should come fresh from reading some of the current stories which tell of the imitative habits of animals and how "monkeys are the most imitative creatures in the world," to an observation such as I have recorded, he would doubtless be surprised. I myself, as hour after hour I watched Jill's indifference to the means of getting food, could hardly believe it credible that she should not perceive the relation between her hunger and the so apparent means of satisfying it. Nothing in her behavior, however, led me to believe that she would have learned from Jack if she had seen him do it a thousand times.

Yet the experiment might not have been quite fair to Jill. Imitative as human beings are, they do not imitate everything they see. Before one could set Jill down as thoroughly stupid, he should present to her the opportunity for imitation under other conditions: he should give her various other problems and devices. This I was about to do when, on entering my laboratory one day, I found Jack doing not as the fabled hero of childhood, who preceded his beloved mate down the hill to destruction, but, alive and well, standing by the prostrate form of Jill. She had died in the night.

The loss of Jill at this time was a serious handicap. Nothing could be done without getting more monkeys. Another pair was obtained by purchase from New York, but neither of them was in good condition, and only one of them was retained. The situation was somewhat discouraging. My year was nearing an end; I had obtained but few results. The best animal was dead, and the new one was a poor specimen. Then a bit of good fortune came along. Through Professor Yerkes, arrangement was made with Dr. Hornaday whereby the investigation could be continued during the summer at the New York Zoölogical Park, where there were monkeys in abundance.

In order to make the most of the facilities at the park, it was necessary to have the apparatus well prepared beforehand. Accordingly, the next few weeks were spent in devising and constructing a new experiment cage.

The new cage was slightly smaller than the old one. The frame was made in sections and put together with bolts. The front and one end were covered with galvanized mesh wire; the back and the other end were covered with twelve-inch, half-tongued boards, placed vertically. These boards were fastened to the frame by bolts with wing-nuts, and could therefore be



NO. 4 PUSHING BACK THE BUTTON IN THE BUTTON EXPERIMENT

easily removed. The mechanical devices which were to be used as problems for the monkeys to solve were adjusted in separate boards. The cage was made ready for an experiment by removing one of the plain boards and substituting in its place a board containing a device. In all, there were seven problems, which I designated as follows: chute experiment B, rope experiment, paper experiment, screen experiment, plug experiment, button experiment, and string experiment.

Chute experiment B was a modification of the device used in the chute experiment A, which I have already described. The food-door, instead of being in the top of the cage, was placed inside the chute. A feeder, which was operated by the experimenter's pulling a string, was adjusted so that it would drop food to the trap-door in the chute. The animal could get this food by leaping to the chute, thrusting a hand up inside, and pulling the string.

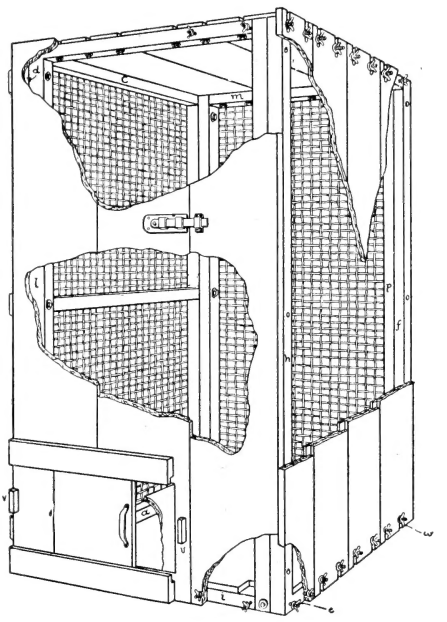


DIAGRAM OF THE NEW CAGE

For a description see page 548-9

For the rope experiment, an opening two inches square was cut near the top of one of the boards at the back of the cage. Into this opening was fitted a door which was hinged to open outward, and which, when closed, was flush with the inside of the board. Before this door a rope was suspended from the top of the cage to the floor. Outside the door was food. The monkey could get food by climbing the rope and pushing open the food-door.

For the paper experiment, an opening about seven inches square was cut in the end board so near the floor that the monkeys could reach it easily when standing upright. On the outside of this board was adjusted a door, in the center of which was a circular opening two inches in diameter. The food-box was fastened to the outside of this door below the opening. With the door open, a sheet of ordinary letter paper was laid over the opening in the board, and the door was then closed upon it. In this way the opening and the food behind it were obscured by the paper. The monkey could get the food by tearing the paper away from the hole.

This same device, with the paper omitted, was used for the screen experiment. The hole in the food-door was obscured by a wooden screen, which was adjusted on the inside of the board. The screen was arranged to slide up and down in a frame. In order to reveal the opening, it must be pushed up at least eight inches. The only way the animal could do this when standing on the floor was to place his hands flat against the screen and give an upward push.

For the plug and button experiments an opening was made in the back of the cage, near the floor, and near the wire end. It was covered by a slide door adjusted on the outside of the board. The door was glass, and the monkeys could see the food on the outside of the cage. In the plug experiment, a string, attached to the slide door, passed down underneath the cage and up the corner post opposite the door. The end of the string was fastened to a plug which fitted into a hole from the inside, half-way up this post. The animal could open the door by pulling out this plug. He could then get food by going to the door.

In the button experiment the slide door was opened by a wooden button on the inside of the cage and about thirty-six inches from the door. From the back of this button a string passed out through an opening and along the back of the cage to the door. The button was near enough to the floor for the monkeys to reach it easily. To open the door, the button, which was fastened to the board by a bolt at the top,

NO. 5. *CEBUS CAPUCINUS;* FEMALE, SEVEN YEARS OLD

She was an old inhabitant of the Park, always hungry, always working to get food, afraid of persons, but her record in learning was equal to that of Jack's.

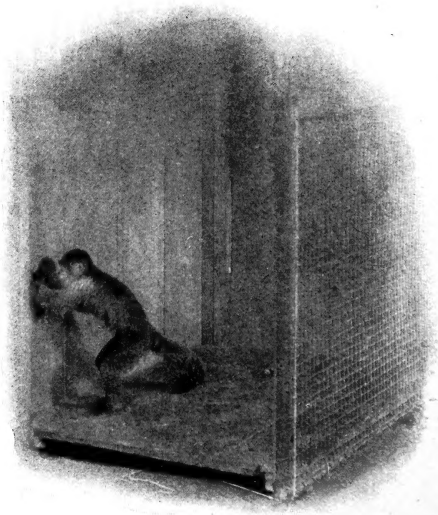
must be moved to the right through an arc of about 30 degrees.

The apparatus for the string experiment was arranged as follows: Strings were dropped from the top of the cage downward along each of the corner posts to within eight inches of the floor. In a similar manner three other strings were dropped from the top along the back of the cage. In the back of the cage near the bottom was a circular opening two inches in diameter. On the outside of the cage was a small chute, the bottom of which was on a level with the circular opening in the cage. In this chute was a trap-door to which could be attached any one of the strings which hung on the inside of the cage. It was originally intended that the experiment could be varied by attaching the several strings in succession. In the actual carrying out of the experiments, there was time for using only one string. Food was supplied to the trap-door by the feeder used in the chute experiment B. When the monkey pulled the string, the food dropped to the bottom of the chute and rolled into the cage through the circular opening.

The seven problem devices which have just been described were perfected only after extended preliminary experimentation with the two monkeys in the old cage. Provisional devices were set up, and the monkeys were given opportunity to manipulate them. As a result of observations on their behavior, the devices were improved and adjusted in the new cage. When all was complete, the new cage and the two animals, each of which had been trained to get food in one or another of the experiments, were shipped to New York. Thanks to the generous interest of Dr. Hornaday, director of the park, it was possible to continue the investigation under exceedingly favorable circumstances.

From the large number of monkeys in the Primates' House, eight were selected for the investigation. Five of these were Cebus monkeys similar to Jack and Jill, and three were Macacus. The latter is an Old-World genus embracing about twenty-five species. They are larger than the Cebus, have short thumbs and nonprehensile tails. They are strong, very vigorous, and less inclined to be tamed.

The method of experimentation was as follows: First, a monkey was given an opportunity to solve a problem by itself. For this purpose it was put into the experiment cage, fifteen minutes at a time, on five successive days. In case it did not learn to get food alone, it was given an opportunity to see another monkey manipulate the device. After this, it was given another opportunity to do the trick alone. The imitator was given ten minutes after



NO. 5 GETTING FOOD IN THE PLUG EXPERIMENT

She has just pulled the plug, which hangs down the post in the new cage.

NO. 6 GETTING FOOD IN ROPE EXPERIMENT
He has just pushed open the door in the new cage.

the other had been removed. In case the monkey still failed to get food, this imitation test was repeated. No monkey was counted to have failed until it had seen an act performed a hundred times and was still unable to do it alone. During all this procedure, both in the preliminary trials and in the imitation tests, a careful record of the monkey's behavior was made.

In this manner experiments were continued for ten weeks. The monkeys were given hundreds of tests, and the records of their behavior amounted to thousands of words.

At the beginning of the experiments I tried to keep an open mind; but in spite of my efforts, I found myself anticipating negative results. Professor Thorndike's monkeys had failed to learn by imitation, Jill's behavior had confirmed his reports, and soon after I reached New York, there came to my hand the report of Professor Watson's work at the University of Chicago, in which he declared "without the slightest hesitation" that in his experiment on monkeys there was "never the slightest evidence of inferential imitation." However, I was determined to try the case out, to give the monkeys another chance to exhibit their intelligence, and, if they failed, to pile up yet more evidence on the negative side.

It came as a surprise, therefore, when, within a week, No. 3 learned to get food in the paper experiment by watching Jack. The first-named monkey had had his five preliminary trials, and the paper had remained untouched. Then Jack was put into the cage. When Jack tore the paper and got food, No. 3 saw him. The paper was replaced, and Jack tore it again; No. 3 became more attentive. The next time Jack tore it, No. 3 went to the paper. In the eleventh performance No. 3 helped tear the paper, and after the thirteenth he bit a hole in the paper and got food.

A few days later Jack learned to get food in the rope experiment by watching No. 3. Then followed two cases of imitation in the plug experiment, and two more in the rope experiment. But I was still skeptical. A few isolated cases might be merely accidental, and might not denote any general imitative ability on the part of the monkeys. All of the cases so far had been delayed imitation; it had required successive performances of one monkey before the imitator finally succeeded.

NO. 6 TEARING PAPER IN ORDER TO GET FOOD

NO. 11. *MACACUS RHESUS;* MALE, THREE YEARS OLD

He was very vigorous, learned to get food in the chute experiment by watching No. 4, and was a good fighter.

I resolved to try the chute again, and with this experiment I was led to believe that the imitative tendency in monkeys was very deep-seated.

No. 4 was a large, vigorous, female Cebus monkey. She was given her preliminary trials, during which she gave no attention whatever to the chute. Then to make sure that she did not merely follow her companion about the cage and to the chute, she was placed inside a wire-covered observation box. This box was set on the floor of the experiment cage. Jack was set free in the cage to get food. No. 4 was alert, for he was a stranger to her. Whenever he moved, she jumped at the side of her box, as if to get hold of him. Jack was frightened; he shrank into a far corner of the cage, and squeezed himself into the smallest possible space. It was so for an hour. If Jack moved, No. 4 jumped, and Jack always retreated. Once something outside the cage attracted her attention; when her head was turned away, Jack gave one leap to the front of the cage and another to the chute. Like a flash he swung down, pulled the string, and dropped to the floor. No. 4 turned her head just in time to see him grab up a peanut and retreat to his corner. She was frantic to get out of the box, and Jack was so frightened that he did not go to the chute again during the morning.

Late in the afternoon the test was repeated; Jack was hungry, and went at once to the chute. No. 4 was all attention. She did her best to get out of the box. When Jack had obtained food, he was taken out, and No. 4 was released from her box. At once she climbed the wire front and leaned toward the chute. She quickly drew back, and descended to the floor. She climbed the wire end of the cage opposite the chute, and, throwing her head and shoulders toward it, caught hold of the lower part of it. She swung loose from the wire, caught the rungs in her feet, wrapped her tail about the chute, threw her head down, looked up the inside of the chute, and thrust up a hand. The iron rattled against the chute, and her arm gave a vigorous jerk. The peanuts fell upon her chest and then to the floor. All of this occurred within forty seconds from the removal of Jack. She repeated the performance a dozen times as rapidly as she could eat the food.

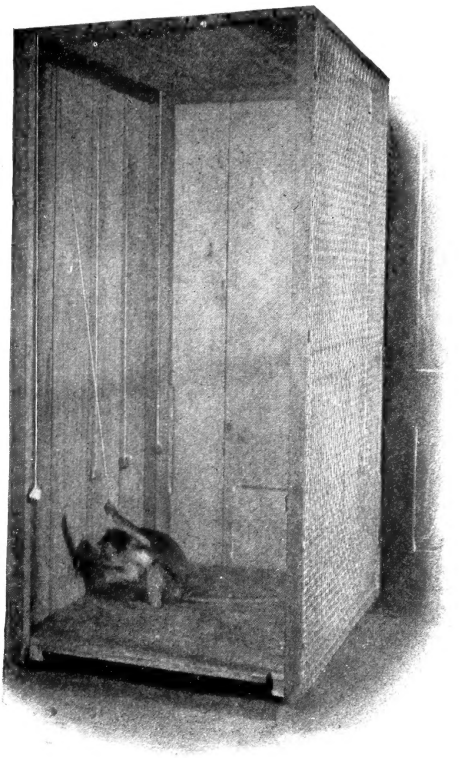
My conversion to a belief in the ability of monkeys to learn by imitation soon received further justification, for, shortly after, two other monkeys duplicated the behavior of No. 4, and No. 11 learned to get food from the chute by a process of gradual imitation.

What I mean by "gradual imitation" may be illustrated by the behavior of No. 13 in the string experiment. No. 5 had been taught to pull the string to get food from

NO. 13. *MACACUS CYNOMOLGUS;* MALE, FOUR YEARS OLD

He was very attentive to other animals, a good fighter, imitated in the chute experiment and in the string experiment; a very intelligent monkey.

the circular opening. After No. 13 had failed to solve the problem in his preliminary trials, he was allowed to see her pull the string. During the first tests he was confined, as No. 4 had been in the case of the chute. After four tests he still failed when left alone in the cage. He was then put into the experiment cage with No. 5. The two animals were strange to each other, and No. 13, being the larger, was inclined to follow No. 5 about the cage, punishing her as opportunity offered. Because of this, he was usually near No. 5 when she pulled the string, and often frightened her away before she could get the food. After she had been removed, No. 13 repeatedly searched the food-opening, and worked alternately with the three strings nearest it. He seemed to have associated the strings with the getting of food. No. 5 was put back into the cage, and was allowed to get food again. No. 13 was even more attentive than formerly. After No. 5 had been removed, No. 13 worked more continuously at L and at the strings. He now singled out string 2 from the others. He seized the knob at the end of the string in his hands, he pounded it against the board, carried it up the wire, and pounded it against the knobs attached to the other strings. Frequently during this behavior he dropped the string and searched L for food. He had advanced one step in his learning: it was not strings that were associated with the getting of food, but a particular string. The only possible explanation for this centering of attention on a particular string was that No. 13 was imitating the act of No. 5.



NO. 13 PULLING THE STRING AND GETTING FOOD

His tense position indicates the eagerness with which he worked.

Imitation, however, was not yet perfect. No. 13 withdrew up the front of the cage, and, perching upon a brace, sat looking at L and the string. He seemed puzzled. He went to the floor and sat down in front of L, looking intently, but he did not touch the string or the opening. Again he perched on the brace and looked at the string and at L. Again he went to the floor and sat in front of the food-opening. Quite deliberately he looked the situation over. Then in the same deliberate manner he looked up to string 2, took hold of the knob in his left hand, and gave a steady and vigorous pull. The food dropped to the bottom of the chute, and his right hand shot into the opening and pulled it out. He ate the food, and immediately pulled the string again. Then for fifteen minutes he sat before L and got food. He never forgot the trick. Such ability to learn by watching the behavior of other monkeys must be of great importance in the normal life of primates, and goes far to account for the high position that they hold in the scale of animal intelligence.

That the tendency of monkeys to learn by imitation is deep-seated, is shown by the total results of my investigation. No one of the seven experiments failed to yield at least one case of imitation. Four of the experiments yielded imitation, successful or partly successful for every animal given the full series of tests. The other three gave a total of five failures. As a whole, the investigation yielded sixteen cases of successful imitation, three of which were immediate.

Of the eleven animals used, all but two

exhibited imitative behavior. Seven of them were successful in each experiment in which they were used.

Jack vied with No. 5, a female Cebus, for the best record, but lost because he failed to learn the string experiment alone, and time did not permit his being given the imitation tests. No. 5 solved three of the problems alone or with slight help from me, and learned the other four by imitation. Four other animals imitated at every opportunity, but they cannot be compared with the two above because they were given fewer tests.

The monkeys exhibited five levels of imitative behavior, which may be summarized as follows: (a) simple arrest of attention; (b) following; (c) reaction to locality; (d) reaction to an object; (e) exact repetition in detail of an act witnessed.

By the "simple arrest of attention" I mean that the monkeys watch one another. One animal walks across the floor of the cage or climbs a pole, and another animal looks in its direction. That monkeys manifest this sort of reaction requires no extended experimentation to prove. Every moving object, and much more every moving monkey, catches their attention.

A level of social response more advanced than mere *looking* is *following*. Closely akin to this is behavior of the sort in which one animal performs an act, and another animal at once repeats the act. It requires but little observation of monkeys to show that the tendency to imitate in this way is present. Not one of the species which I have studied failed to follow, and there were cases in which the monkeys repeated the act of another when it was unaccompanied by any profitable result.

More complicated than looking or following is what I choose to call reaction to locality. It often happened that one monkey would go to a certain part of the cage, get food, and go away. Another monkey which had observed this behavior would then go to that portion of the cage and hunt about, but would not attack the button, string, or plug necessary to get the food.

It denotes a level of behavior distinctly higher when the observing monkey not only goes to a certain locality, but attacks a particular object in that locality. In the rope experiment, No. 4 climbed the rope after she had seen Jack get food. She looked all about that portion of the top of the cage. She smelled about the edges of the food-door. She put her hand on the door, and rubbed it up and down. She did not, however, push on the door to open it. Here the particular object was singled out, but the exact movement was not repeated.

Of a distinctly higher grade would seem to be the behavior of No. 3 in the button experiment. That animal had failed during his preliminary trials to move the button or to be interested in it. After seeing another monkey push the button in the imitation test, he went to it, and, seizing it in his hand, gave a vigorous push to the right, just as he had seen the other monkey do. Here we have exact repetition in detail of the act witnessed.

In conclusion, let me indicate in what direction such investigations lead. The experimental movement which has characterized the last quarter-century of human psychology has, within ten years, been rigidly applied to the study of the psychic life of animals. The animal mind, hitherto a region of myth and a field for human fancy, has been subjected to severe experimental conditions, with a view to determine accurately what it involves. Studies have been made on the senses, on memory, on the power of association, on the presence of ideas, and on the ability to learn by imitation. Activities in the field have become so numerous that animal psychology may fairly be termed a current scientific movement, a movement in which American universities are holding a foremost place.

As yet, to be sure, the amount of established data is not large, and the data concerning almost any single animal or any single problem is very meager. In view of this scantiness of established facts, most investigators in the field are somewhat chary about hazarding opinions as to what are the psychic accompaniments of any kind of animal behavior. I feel this hesitancy about making any psychic interpretation of the behavior which I have witnessed. I am content at present with the more modest task of describing the behavior of the monkeys, of indicating the levels of perfection of imitative behavior which they exhibited, and of setting forth the conditions under which imitation took place.